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(54) METHOD AND DEVICE FOR GENERATING SIMULATED INTERFERENCE

(57) Embodiments of the present invention provide a method and an apparatus for generating a simulated interference, which are used to obtain a simulated interference of which an interference characteristic is consistent with an interference characteristic of a real user equipment, thereby more objectively reflecting system performance in different scenarios, enhancing a technical evaluation effect, and improving technical evaluation efficiency. The embodiments of the present invention include: configuring interference characteristic parameters, where the interference characteristic parameters are used to simulate one interference or a type of interference that has a same interference characteristic, and the interference characteristic parameters include a transmission mode, a rank Rank, and a precoding matrix indicator PMI; and generating a simulated interference by using the interference characteristic parameters.

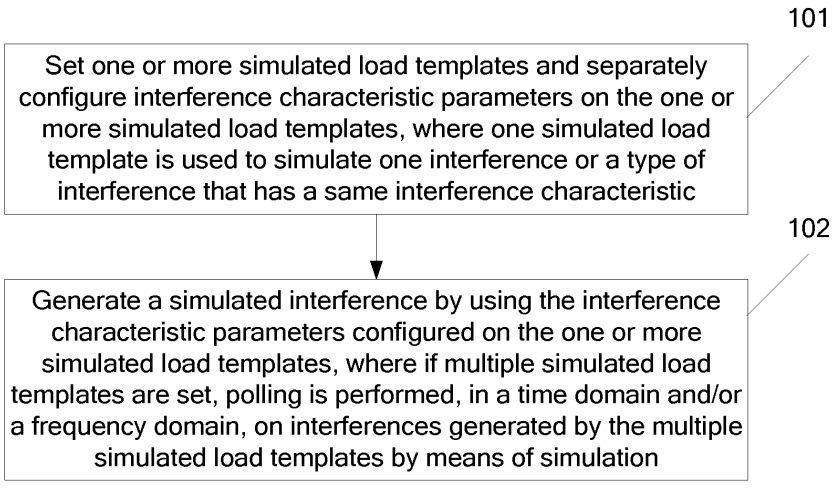

FIG. 1

EP 2 999 147 A1

Description

[0001] This application claims priority to Chinese Patent Application No. 201310283161.1, filed with the Chinese Patent Office on July 5, 2013 and entitled "METHOD AND APPARATUS FOR GENERATING SIMULATED INTERFERENCE", which is hereby incorporated by reference in its entirety.

TECHNICAL FIELD

[0002] The present invention relates to the field of communications technologies, and in particular, to a method and an apparatus for generating a simulated interference.

BACKGROUND

[0003] A Long Term Evolution (LTE, Long Term Evolution) system supports multiple-input multiple-output (MIMO, Multiple-Input Multiple-Output) transmission. Based on traditional transmission in a time domain and a frequency domain, spatial dimension division is added in this technology, to provide higher flexibility for downlink transmission. LTE physical layer specifications of the 3rd Generation Partnership Project (3GPP, 3rd Generation Partnership Project) Release 8 and Release 9 provide multiple transmission technologies, such as open-loop downlink transmit diversity, open-loop spatial multiplexing, closed-loop spatial multiplexing, and beam forming, to adapt to different system configuration, user equipment (UE, User Equipment) capabilities, and channel environments.

[0004] In a commercial LTE system, in addition to a serving cell, a neighboring cell generally has a specific quantity of user equipments that are performing data transmission. To better evaluate performance of MIMO in a multi-cell scenario, a co-channel interference among cells needs to be simulated by means of neighboring cell loading. Generally, neighboring cell loading is implemented in two manners: The first one is to generate an interference in the neighboring cell by using a real user equipment, and the second one is to generate an interference by using a simulated load mode.

[0005] However, properties of interference signals generated by using different transmission technologies are different. For example, the open-loop transmit diversity technology transmits only a single code word; the closed-loop spatial multiplexing may transmit one to two code words and multiple data streams, and an interference signal has directivity to some extent; and an interference signal of the beam forming technology also has directivity to some extent. Impact of interference signals generated by using different transmission technologies is also different. Under a condition of same power, more layers of spatial multiplexing indicate severer impact of an interference. For example, impact of an interference source of spatial multiplexing is greater than impact of an interference source of transmit diversity.

[0006] That is, how to generate a simulated interference and a property of an interference source have significant impact on system performance. An existing method for generating a simulated interference uses a single single-stream transmission scheme to generate a simulated interference. This is equivalent to that there is only one interference user equipment, or although there are multiple interference user equipments, all interference user equipments have a unique interference characteristic. That is, there is only a single code word, a rank is equal to 1, an interference has no directivity, and in addition, there is an obvious difference between a simulated interference and an interference of a real user equipment, so that performance of a commercial system cannot be objectively evaluated.

SUMMARY

[0007] Embodiments of the present invention provide a method and an apparatus for generating a simulated interference, which are used to obtain a simulated interference of which an interference characteristic is consistent with an interference characteristic of a real user equipment, thereby more objectively reflecting system performance in different scenarios, enhancing a technical evaluation effect, and improving technical evaluation efficiency.

[0008] In view of this, according to a first aspect of the present invention, a method for generating a simulated interference is provided, and the method includes:

setting one or more simulated load templates and separately configuring interference characteristic parameters on the one or more simulated load templates, where one simulated load template is used to simulate one interference or a type of interference that has a same interference characteristic; and

generating a simulated interference by using the interference characteristic parameters configured on the one or more simulated load templates, where if multiple simulated load templates are set, polling is performed, in a time domain and/or a frequency domain, on interferences generated by the multiple simulated load templates by means of simulation.

[0009] In a first possible implementation manner of the first aspect, the interference characteristic parameters include a transmission mode, a resource utilization rate, a rank Rank, a precoding matrix indicator PMI, a modulation and coding scheme MCS, and a time domain polling granularity or a frequency domain polling granularity of the one or more simulated load templates, where

the configuring interference characteristic parameters on the one or more simulated load templates includes: separately configuring the transmission mode, the resource utilization rate, the Rank, the

PMI, the MCS, and the time domain polling granularity or the frequency domain polling granularity of the one or more simulated load templates.

[0010] With reference to the first possible implementation manner of the first aspect, in a second possible implementation manner,

the configuring the transmission mode of the one or more simulated load templates includes: configuring the transmission mode or a transmission scheme of the one or more simulated load templates, and accepting or not accepting a restriction of a characteristic license of an interference cell;
the configuring the resource utilization rate of the one or more simulated load templates includes: configuring a resource block RB utilization rate and a transmit power utilization rate of the interference cell, where if an RB utilization rate or a transmit power utilization rate that is scheduled by the interference cell and is of a real user equipment UE is lower than a preset threshold, simulated load is scheduled; or if an RB utilization rate or a transmit power utilization rate that is scheduled by the interference cell and is of a real UE is higher than a preset threshold, simulated load is invalid;
the configuring the Rank and the PMI of the one or more simulated load templates includes: according to the configured transmission mode, setting each of a Rank and a PMI that are corresponding to the transmission mode to a specific value or a preset value range;
the setting the MCS of the one or more simulated load templates includes: configuring the MCS of the one or more simulated load templates to a specific value or a preset value range; and
the configuring the time domain polling granularity or the frequency domain polling granularity includes: if multiple simulated load templates are set, separately setting the time domain polling granularity or the frequency domain polling granularity of the simulated load templates to a specific value or a preset value range, where a preset value range of the time domain polling granularity is from 1 ms to infinity, and a preset value range of the frequency domain polling granularity is 1-100 RB.

[0011] With reference to the first aspect or the first or the second possible implementation manner of the first aspect, in a third possible implementation manner, the generating a simulated interference by using the interference characteristic parameter configured on the one or more simulated load templates includes:

based on different transmission modes and according to a Rank and/or a PMI and/or an MCS configured at a Media Access Control MAC layer or a Radio Resource Control RRC layer, generating a simulated interference; and performing polling between the multiple simulated load templates according to the configured time domain polling granularity or the configured frequency domain polling granularity.

[0012] With reference to the first aspect or the first or the second possible implementation manner of the first aspect, in a fourth possible implementation manner, the method further includes:

copying the interference characteristic parameters of the one or more simulated load templates to one or more simulated user equipments, and loading simulated load to the interference cell by using the one or more simulated user equipments, to reach a preset resource utilization rate of the simulated load.

[0013] With reference to the first aspect or the first or the second possible implementation manner of the first aspect, in a fifth possible implementation manner, the method further includes:

based on a manner in which an ICIC function is enabled for an interference cell, copying the interference characteristic parameters of the one or more simulated load templates to one or more simulated user equipments, and loading simulated load to a center frequency band and an edge frequency band by using the one or more simulated user equipments, to reach a preset resource utilization rate of the simulated load.

[0014] With reference to the first aspect or the first or the second possible implementation manner of the first aspect, in a sixth possible implementation manner, the method further includes:

if a Radio Resource Control RRC layer only configures some of the interference characteristic parameters, for an interference characteristic parameter that is not configured, performing simulated scrambling according to a default value or in a default manner; or
if the RRC layer only configures some of the interference characteristic parameters and the configured interference characteristic parameters are configured as a preset value range, performing simulated scrambling in a manner of performing random selection or polling selection within the preset value range.

[0015] According to a second aspect of the present invention, an apparatus for generating a simulated interference is provided, and the apparatus includes:

a parameter configuring module, configured to separately configure interference characteristic parameters on one or more set simulated load templates,

where one simulated load template is used to simulate one interference or a type of interference that has a same interference characteristic; and

a simulated interference generating module, configured to generate a simulated interference by using the interference characteristic parameters configured on the one or more simulated load templates, where if multiple simulated load templates are set, polling is performed, in a time domain and/or a frequency domain, on interferences generated by the multiple simulated load templates by means of simulation.

[0016] In a first possible implementation manner of the second aspect, the interference characteristic parameters include a transmission mode, a resource utilization rate, a rank Rank, a precoding matrix indicator PMI, a modulation and coding scheme MCS, and a time domain polling granularity or a frequency domain polling granularity of the one or more simulated load templates.

[0017] With reference to the first possible implementation manner of the second aspect, in a second possible implementation manner,

the parameter configuring module is specifically configured to configure the transmission mode of the one or more simulated load templates, configure the resource utilization rate of the one or more simulated load templates, configure the Rank and the PMI of the one or more simulated load templates, configure the MCS of the one or more simulated load templates, and configure the time domain polling granularity or the frequency domain polling granularity, where the configuring the transmission mode of the one or more simulated load templates includes: configuring the transmission mode or a transmission scheme of the one or more simulated load templates, and accepting or not accepting a restriction of a characteristic license of an interference cell; the configuring the resource utilization rate of the one or more simulated load templates includes: configuring a resource block RB utilization rate and a transmit power utilization rate of the interference cell, where if an RB utilization rate or a transmit power utilization rate that is scheduled by the interference cell and is of a real user equipment UE is lower than a preset threshold, simulated load is scheduled, or if an RB utilization rate or a transmit power utilization rate that is scheduled by the interference cell and is of a real UE is higher than a preset threshold, simulated load is invalid; the configuring the Rank and the PMI of the one or more simulated load templates includes: according to the configured transmission mode, setting each of a Rank and a PMI that are corresponding to the transmission mode to a specific value or a preset value range; the configuring the MCS of the one or more simulated load templates includes: setting the MCS of the one or more simulated load templates to a specific value or a preset value range; and the configuring the time domain polling granularity or the frequency domain polling granularity includes: if multiple simulated load templates are set, separately setting the time domain polling granularity or the frequency domain polling granularity of the simulated load templates to a specific value or a preset value range, where a preset value range of the time domain polling granularity is from 1 ms to infinity, and a preset value range of the frequency domain polling granularity is 1-100 RB.

[0018] With reference to the second aspect or the first or the second possible implementation manner of the second aspect, in a third possible implementation manner, the simulated interference generating module is specifically configured to, based on different transmission modes and according to a Rank and/or a PMI and/or an MCS configured at a Media Access Control MAC layer or a Radio Resource Control RRC layer, generate a simulated interference; and perform polling between the multiple simulated load templates according to the configured time domain polling granularity or the configured frequency domain polling granularity.

[0019] With reference to the second aspect or the first or the second possible implementation manner of the second aspect, in a fourth possible implementation manner, the apparatus further includes a parameter copying module, where the parameter copying module is configured to copy the interference characteristic parameters of the one or more simulated load templates to one or more simulated user equipments, and load simulated load to the interference cell by using the one or more simulated user equipments, to reach a preset resource utilization rate of the simulated load.

[0020] With reference to the second aspect or the first or the second possible implementation manner of the first aspect, in a fifth possible implementation manner, the apparatus further includes a parameter copying module, where the parameter copying module is configured to, based on a manner in which an ICIC function is enabled for an interference cell, copy the interference characteristic parameters of the one or more simulated load templates to one or more simulated user equipments, and load simulated load to a center frequency band and an edge frequency band by using the one or more simulated user equipments, to reach a preset resource utilization rate of the simulated load.

[0021] With reference to the second aspect or the first or the second possible implementation manner of the first aspect, in a sixth possible implementation manner, the simulated interference generating module is further configured to: if the Radio Resource Control RRC layer only configures some of the interference characteristic parameters, for an interference characteristic parameter that is not configured, perform simulated scrambling according to a default value or in a default manner; or if the RRC layer only configures some of the interference char-

acteristic parameters and the configured interference characteristic parameters are configured as a preset value range, perform simulated scrambling in a manner of performing random selection or polling selection within the preset value range.

[0022] It can be learned from the foregoing technical solutions that, the method and apparatus for generating a simulated interference provided in the embodiments of the present invention have the following advantages: Interference characteristic parameters may be configured for each interference source or each type of interference source, and a simulated interference may be generated according to the configured interference characteristic parameters. Therefore, an interference effect consistent with that of a real user equipment may be achieved, thereby more objectively reflecting system performance in different scenarios, saving a test investment and cost, and improving test efficiency.

BRIEF DESCRIPTION OF DRAWINGS

[0023] To describe the technical solutions in the embodiments of the present invention more clearly, the following briefly introduces the accompanying drawings required for describing the embodiments. Apparently, the accompanying drawings in the following description show merely some embodiments of the present invention, and a person of ordinary skill in the art may still derive other drawings from these accompanying drawings without creative efforts.

FIG. 1 is a schematic flowchart of a method for generating a simulated interference according to an embodiment of the present invention;

FIG. 2 is another schematic flowchart of a method for generating a simulated interference according to an embodiment of the present invention;

FIG. 3 is a schematic structural diagram of an apparatus for generating a simulated interference according to an embodiment of the present invention; and

FIG. 4 is another schematic structural diagram of an apparatus for generating a simulated interference according to an embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0024] Embodiments of the present invention provide a method and an apparatus for generating a simulated interference, which are used to obtain a simulated interference of which an interference characteristic is consistent with an interference characteristic of a real user equipment, thereby more objectively reflecting system performance in different scenarios, enhancing a technical evaluation effect, and improving technical evaluation efficiency.

[0025] The following clearly and completely describes the technical solutions in the embodiments of the present invention with reference to the accompanying drawings in the embodiments of the present invention. Apparently, the described embodiments are merely some but not all of the embodiments of the present invention. All other embodiments obtained by a person of ordinary skill in the art based on the embodiments of the present invention without creative efforts shall fall within the protection scope of the present invention.

[0026] The following separately provides detailed descriptions.

[0027] Referring to FIG. 1, FIG. 1 is a schematic flowchart of a method for generating a simulated interference according to an embodiment of the present invention, where the method includes:

Step 101: Set one or more simulated load templates and separately configure interference characteristic parameters on the one or more simulated load templates, where one simulated load template is used to simulate one interference or a type of interference that has a same interference characteristic.

[0028] That is, each of the one or more simulated load template is corresponding to a type of interference user equipment, which may include one or more interference user equipments but has a same interference characteristic.

[0029] Step 102: Generate a simulated interference by using the interference characteristic parameters configured on the one or more simulated load templates, where if multiple simulated load templates are set, polling is performed, in a time domain and/or a frequency domain, on interferences generated by the multiple simulated load templates by means of simulation.

[0030] In this embodiment of the present invention, the interference characteristic parameters include a transmission mode, a resource utilization rate, a rank Rank, a precoding matrix indicator (PMI, Precoding Matrix Indicator), a modulation and coding scheme (MCS, Modulation and Coding Scheme), and a time domain polling granularity or a frequency domain polling granularity of the one or more simulated load templates. The configuring interference characteristic parameters on the one or more simulated load templates may include: separately configuring the transmission mode, the resource utilization rate, the Rank, the PMI, the MCS, and the time domain polling granularity or the frequency domain polling granularity of the one or more simulated load templates.

[0031] By using an application in a multiple input multiple output MIMO transmission mode as an example, the method for generating a simulated interference provided in this embodiment of the present invention is used to obtain a simulated interference of which an interference characteristic is consistent with an interference characteristic of a real user equipment. It may be understood that, the method is also applicable to single-input single-output (SISO, SISO Single Input Single Out), single-input multiple-output (SIMO, SIMO Single Input Mul-

tiple Out), and multiple-input single-output (MISO, MISO Multiple Input Single Out). Although there is only one transmit antenna in SIMO and SISO, and a corresponding transmission mode or transmission scheme cannot be configured, an interference may still be simulated more objectively by configuring parameters, such as a quantity of users and an MCS, which is not specifically limited herein.

[0032] It can be learned from the foregoing description that, according to the method for generating a simulated interference provided in this embodiment of the present invention, interference characteristic parameters may be configured for each interference source or each type of interference source, and a simulated interference may be generated according to the configured interference characteristic parameters. Therefore, an interference effect consistent with that of a real user equipment may be achieved, thereby more objectively reflecting system performance in different scenarios, saving a test investment and cost, and improving test efficiency.

[0033] Referring to FIG. 2, FIG. 2 is another schematic flowchart of a method for generating a simulated interference according to an embodiment of the present invention, where the method includes:

Step 201: Separately configure a transmission mode, a resource utilization rate, a Rank, a PMI, an MCS, and a time domain polling granularity or a frequency domain polling granularity of one or more simulated load templates.

[0034] Preferably, the configuring the transmission mode of the one or more simulated load templates includes:

configuring the transmission mode or a transmission scheme of the one or more simulated load templates, and accepting or not accepting a restriction of a characteristic license of an interference cell. The configured transmission mode only affects data transmission through a physical downlink shared channel (PDSCH, Physical Downlink Shared Channel), but does not affect pilot transmission of a cell-specific reference signal (CRS, Cell-specific Reference Signal) or values of parameters, such as pilot transmit power, Pa, and Pb, so that simulated load and inter-cell interference coordination (ICIC, Inter-Cell Interference Coordination) may co-exist.

[0035] The characteristic license of the interference cell may include MIMO or BF (beam forming, beam forming), and may further include another characteristic, such as an active antenna system (AAS, Active Antenna System), frequency-selective scheduling, ICIC, or a power class.

[0036] Preferably, the configuring the resource utilization rate of the one or more simulated load templates includes:

configuring a resource block (RB, Resource Block) utilization rate and a transmit power utilization rate of an interference cell, where if an RB utilization rate or a transmit power utilization rate that is scheduled by the interference cell and is of a real user equipment (UE, User Equipment) is lower than a preset threshold, simulated load is scheduled; or if an RB utilization rate or a transmit power utilization rate that is scheduled by the interference cell and is of a real UE is higher than a preset threshold, simulated load is invalid.

[0037] That is, the resource utilization rate includes the RB utilization rate and the transmit power utilization rate of the interference cell, and an RB utilization rate threshold or a transmit power utilization rate threshold is preset.

[0038] Preferably, the configuring the MCS of the one or more simulated load templates includes:

setting the MCS of the one or more simulated load templates to a specific value or a preset value range, that is, a subset from 0 to 28.

[0039] Preferably, the configuring the time domain polling granularity or the frequency domain polling granularity includes:

if multiple simulated load templates are set, separately setting the time domain polling granularity or the frequency domain polling granularity of the simulated load templates to a specific value or a preset value range, where a preset value range of the time domain polling granularity is from 1 ms to infinity, and a preset value range of the frequency domain polling granularity is 1-100 RB.

[0040] Preferably, the configuring the Rank and the PMI of the one or more simulated load templates includes:

according to the configured transmission mode, setting each of a Rank and a PMI that are corresponding to the transmission mode to a specific value or a preset value range. For a specific value range, refer to Table 1. Table 1 lists value ranges of valid Ranks or PMIs in different transmission modes.

Table 1

Transmission Mode	Rank	PMI
TM1	1	N.A.
TM2	1	N.A.
TM3	1-4	N.A.
TM4	1-4	0-15
TM5	1	0-15
TM6	1	0-15

(continued)

Transmission Mode	Rank	PMI
TM7	1	N.A.
TM8	1-2	0-15
TM9	1-8	PMI1: 0-15 PMI2: 0-15

[0041] It should be noted that, with reference to Table 1 and according to the configured interference characteristic parameters, the following briefly describes a form of generating a simulated interference in each transmission mode defined by an LTE specification.

[0042] Based on transmission modes TM1, TM2, and TM3, the PMI is marked as N.A, and N.A indicates that configuration is not required or configuration is invalid. No matter whether and how a Radio Resource Control (RRC, Radio Resource Control) layer (L3 for short) configures the PMI, a physical layer (L1 for short) and a Media Access Control (MAC, Media Access Control) layer (L2 for short) generate a precoding matrix and a physical downlink shared channel PDSCH signal according to the LTE specification 36.211. It may be understood that L1, L2, and L3 belong to framework content of an eNodeB, and are not specifically explained herein.

[0043] Based on transmission mode TM7, the PMI is marked as N.A, that is, it indicates that no matter how L3 configures the PMI, L2 and L1 generate a beam forming matrix and a PDSCH signal according to a used beam forming technology.

[0044] Based on transmission mode TM8 or TM9, the PMI may be configured or may not be configured. If the PMI is configured, a precoding matrix and a PDSCH signal are generated according to a codebook defined by the specification 36.211 and the specification 36.213. If the PMI is not configured, a beam forming matrix and a PDSCH signal are generated according to a used beam forming technology.

[0045] It may be understood that, in this embodiment of the present invention, the configuring a simulated interference may further include: configuring a frequency-selective scheduling function of simulated load and configuring a quantity of simulated load templates, where the frequency-selective scheduling function of simulated load indicates whether simulated load uses frequency-selective scheduling. If the function is enabled, frequency-selective scheduling is used; if the function is disabled, non-frequency-selective scheduling is used. The quantity of simulated load templates indicates the quantity K of templates of the simulated load. A transmission mode or a transmission scheme, and a scheduled Rank, PMI, and MCS may be independently configured for each template. If the quantity of simulated load templates is zero, a simulated interference is generated according to a default transmission scheme or a Rank or an MCS.

[0046] Step 202: Based on different transmission modes and according to a Rank and/or a PMI and/or an MCS configured at a Media Access Control MAC layer or a Radio Resource Control RRC layer, generate a simulated interference.

[0047] Specifically, L2 or L3 generates a simulated interference according to the configured interference characteristic parameters (the Rank and/or the PMI and/or the MCS). In a time domain, an interference of each of the one or more simulated load templates occupies SimuLoadTimePeriod successive transmission time intervals (TTI, Transmission Time Interval), but does not include an orthogonal frequency division multiplexing (OFDM, Orthogonal Frequency Division Multiplexing) symbol in which a physical downlink control channel (PDCCH, Physical Downlink Control Channel) is located. In a case that multiple simulated load templates are set, polling is further performed between the multiple simulated load templates according to the configured time domain polling granularity or the configured frequency domain polling granularity. That is, polling is performed, in a time domain and/or a frequency domain, on interferences generated by the multiple simulated load templates by means of simulation. The parameter SimuLoadTimePeriod may be configured according to an actual situation.

[0048] Reference may be made to Table 1. First, the Rank of the one or more simulated load templates is configured as accepting or not accepting license control of MIMO and BF, and not accepting a codebook subset restriction. It is set that 1T-4T represent a quantity of antenna ports of an eNodeB. For transmission modes TM1, TM2, and TM3, a PMI that is input by L3 is meaningless (that is, configuration of the PMI is not required or configuration is invalid), and L2 generates a precoding matrix according to the specification 36.211. In a 2T closed-loop mode (including transmission mode TM4, TM5, or TM6), a PMI scheduled by L2 performs upper and lower limiting processing according to the Rank and the PMI that is input by L3, to ensure that a PMI of Rank1 is 0-3, and a PMI of Rank2 is 1-2, where Rank1 and Rank2 represent a quantity of spatial independent data streams. For 1T, L2 performs simulated scrambling according to transmission mode TM1 and the configured MCS. For 2T or 4T, if the transmission mode is TM1, simulated scrambling is performed according to TM2 and the configured MCS. For TM7, the PMI that is input by L3 is meaningless, and L2 and L1 generate a beam forming matrix according to a used beam forming technology. For TM8 or TM9, if L3 configures the PMI, a precoding matrix is generated according to the codebook defined by the specification 36.211 and the specification 36.213. If the PMI is not configured, a beam forming matrix is generated according to a used beam forming technology.

[0049] Further preferably, the method for generating a simulated interference may further include:

copying the interference characteristic parameters of the one or more simulated load templates to one or more simulated user equipments, and loading

simulated load to the interference cell by using the one or more simulated user equipments, to reach a preset resource utilization rate of the simulated load.

[0050] Within a TTI, according to a resource allocation type (the LTE specification 36.213 defines three resource allocation types 0, 1, and 2), RB resources are allocated to each simulated load user, so that an RB that can be addressed by a simulated user equipment may not reach a set simulated load level. Therefore, the interference characteristic parameters configured on each of the one or more simulated load templates (equivalent to a simulated load user equipment) need to be copied to one or more simulated user equipments (for example, a maximum of eight user equipments), and reaching a set resource utilization rate of the simulated load is implemented by performing scrambling on these simulated user equipments.

[0051] Further, the method for generating a simulated interference may further include:

based on a manner in which an ICIC function is enabled for an interference cell, copying the interference characteristic parameters of the one or more simulated load templates to one or more simulated user equipments, and loading simulated load to a center frequency band and an edge frequency band by using the one or more simulated user equipments, to reach a preset resource utilization rate of the simulated load.

[0052] If the interference cell enables the ICIC function, a center user and an edge user of the interference cell have different configuration of power control parameters (Pa and Pb). In this case, the parameters configured on each of the one or more simulated load templates are still copied to one or more simulated user equipments (for example, a maximum of 16 user equipments), and reaching the set resource utilization rate of the simulated load is separately implemented in the center frequency band and the edge frequency band by performing scrambling on these simulated user equipments.

[0053] Preferably, the method for generating a simulated interference may further include: if the Radio Resource Control RRC layer only configures some of the interference characteristic parameters, for an interference characteristic parameter that is not configured, performing simulated scrambling according to a default value or in a default manner; or

if the RRC layer only configures some of the interference characteristic parameters and the configured interference characteristic parameters are configured as a preset value range, performing simulated scrambling in a manner of performing random selection or polling selection within the preset value range.

[0054] For example, if the Rank is not configured, simulated scrambling may be performed according to a default Rank1. If the MCS is not configured, simulated scrambling may be performed according to a default MCS; or simulated scrambling may be performed by randomly selecting an MCS; or simulated scrambling may be performed in a manner of performing MCS polling within a range.

[0055] It may be understood that, in combination with the interference characteristic parameters configured by L3, such as the transmission mode, the Rank, the PMI, and the MCS, and with reference to the specification 36.211, pseudo random noise or a specific source signal may be used in this embodiment of the present invention, to generate a PDSCH signal in a processing procedure of a downlink physical channel, and the PDSCH signal is mapped to an antenna of the eNodeB for transmitting.

[0056] It should be noted that, the method for generating a simulated interference may be performed by the eNodeB, and a simulated interference is generated on an eNodeB side according to the configured interference characteristic parameters. An independent apparatus (such as a signal generator) may also be used to generate a simulated interference.

[0057] It can be learned from the foregoing description that, according to a method for generating a simulated interference provided in this embodiment of the present invention, first, interference characteristic parameters are independently configured for each interference source or each type of interference source, where the configured interference characteristic parameters include a quantity of interference sources, and a transmission mode, a PMI, a Rank, an MCS, transmit power, and a time domain polling granularity or a frequency domain polling granularity of each interference source. Then, simulated interference data is generated according to the configured interference characteristic parameters and is sent over an air interface. A simulated interference of which an interference characteristic is consistent with an interference characteristic of a real user equipment may be obtained, thereby more objectively reflecting system performance in different scenarios, saving a test investment and cost, and improving test efficiency. In the technical solutions of the present invention, an interference effect generated by a simulated interference is equivalent to an interference effect generated by using a real UE, thereby better evaluating or demonstrating performance of a specific technology (such as MIMO or AAS) in a multi-cell scenario. Compared with an interference of a real UE, a simulated interference is relatively flexible, and substantially saves materials and a labor cost.

[0058] The following describes another method for generating a simulated interference in an embodiment of the present invention. In this embodiment, the method for generating a simulated interference specifically includes the following steps:

S1. Configure interference characteristic parame-

ters.

[0059] In this embodiment, the interference characteristic parameters are used to simulate one interference or a type of interference that has a same interference characteristic, and the interference characteristic parameters include a transmission mode, a rank Rank, and a PMI.

[0060] S2. Generate a simulated interference by using the interference characteristic parameters.

[0061] After the interference characteristic parameters are configured, a simulated interference may be generated by using these interference characteristic parameters.

[0062] For ease of understanding, the following describes this embodiment in detail.

[0063] In this embodiment, the interference characteristic parameters may include at least the transmission mode, the rank Rank, and the PMI, and a configuring process is specifically as follows:

Configuring the transmission mode includes: configuring the transmission mode or a transmission scheme of the interference characteristic parameters, and accepting or not accepting a restriction of a characteristic license of an interference cell; and

configuring the Rank and the PMI includes: according to the configured transmission mode, setting each of a Rank and a PMI that are corresponding to the transmission mode to a specific value or a preset value range.

[0064] It may be understood that, in an actual application, in addition to the transmission mode, the rank Rank, and the PMI, the interference characteristic parameters may further include other parameters, such as a resource utilization rate and an MCS. In this embodiment, a process of configuring the resource utilization rate and the MCS is specifically as follows:

Configuring the resource utilization rate includes: configuring a resource block RB utilization rate and a transmit power utilization rate of an interference cell, where if an RB utilization rate or a transmit power utilization rate that is scheduled by the interference cell and is of a real user equipment UE is lower than a preset threshold, simulated load is scheduled; or if an RB utilization rate or a transmit power utilization rate that is scheduled by the interference cell and is of a real UE is higher than a preset threshold, simulated load is invalid; and

configuring the MCS includes: setting the MCS to a specific value or a preset value range.

[0065] It may be understood that, in an actual application, in addition to the transmission mode, the rank Rank, and the PMI, the interference characteristic parameters may further include other parameters. For example, when multiple groups of interference characteristic parameters exist, the interference characteristic parameters may further include a time domain polling granularity and/or a frequency domain polling granularity. A process of configuring the time domain polling granularity and/or the frequency domain polling granularity is specifically:

separately setting a time domain polling granularity and/or a frequency domain polling granularity of each of the multiple groups of interference characteristic parameters to a specific value or a preset value range, where a preset value range of the time domain polling granularity is from 1 ms to infinity, and a preset value range of the frequency domain polling granularity is 1-100 RB.

[0066] In this embodiment, an apparatus for generating a simulated interference may generate the simulated interference based on different transmission modes and according to a Rank and/or a PMI configured at an RRC layer.

[0067] When multiple groups of interference characteristic parameters exist, the apparatus for generating a simulated interference may generate the simulated interference based on different transmission modes and according to a Rank and/or a PMI configured at an RRC layer; and perform polling between the multiple groups of interference characteristic parameters according to the configured time domain polling granularity and/or the configured frequency domain polling granularity, so that polling is performed, in a time domain or a frequency domain, on simulated interferences generated by the multiple groups of interference characteristic parameters.

[0068] It should be noted that, if an RB that can be addressed by a simulated user equipment cannot reach a set simulated load level, the interference characteristic parameters may be further copied to one or more simulated user equipments, and simulated load is loaded to the interference cell by using these simulated user equipments, to reach a preset resource utilization rate of the simulated load.

[0069] In addition, if an ICIC function is enabled for an interference cell, the apparatus for generating a simulated interference may copy the interference characteristic parameters to one or more simulated user equipments, and load simulated load to a center frequency band and an edge frequency band by using these simulated user equipments, to reach a preset resource utilization rate of the simulated load.

[0070] To better implement the method for generating a simulated interference provided in the embodiments of the present invention, the embodiments of the present invention further provide an apparatus based on the foregoing method for generating a simulated interference. Meanings of nouns are the same as those in the foregoing method. For specific implementation details, refer to de-

scriptions in the method embodiments.

[0071] Referring to FIG. 3, FIG. 3 is a schematic structural diagram of an apparatus for generating a simulated interference according to an embodiment of the present invention, where the apparatus is applied to the methods for generating a simulated interference in the foregoing embodiments, and the apparatus includes:

a parameter configuring module 301, configured to separately configure interference characteristic parameters on one or more set simulated load templates, where one simulated load template is used to simulate one interference or a type of interference that has a same interference characteristic;

that is, each of the one or more simulated load template is corresponding to a type of interference user equipment, which may include one or more interference user equipments but has a same interference characteristic; and

a simulated interference generating module 302, configured to generate a simulated interference by using the interference characteristic parameters configured on the one or more simulated load templates, where if multiple simulated load templates are set, polling is performed, in a time domain and/or a frequency domain, on interferences generated by the multiple simulated load templates by means of simulation.

[0072] In this embodiment of the present invention, the interference characteristic parameters include a transmission mode, a resource utilization rate, a rank Rank, a precoding matrix indicator PMI, and a modulation and coding scheme MCS, and a time domain polling granularity or a frequency domain polling granularity of the one or more simulated load templates. The parameter configuring module 301 is configured to separately configure the transmission mode, the resource utilization rate, the Rank, the PMI, the MCS, and the time domain polling granularity or the frequency domain polling granularity of the one or more simulated load templates.

[0073] The apparatus for generating a simulated interference provided in this embodiment of the present invention may be applied to a transmission mode of multiple-input multiple-output MIMO, and is used to obtain a simulated interference of which an interference characteristic is consistent with an interference characteristic of a real user equipment. It may be understood that, the apparatus may also be applied to single-input single-output (SISO, SISO Single Input Single Out), single-input multiple-output (SIMO, SIMO Single Input Multiple Out), and multiple-input single-output (MISO, MISO Multiple Input Single Out), which is not specifically limited herein.

[0074] It can be learned from the foregoing description that, according to the apparatus for generating a simulated interference provided in this embodiment of the present invention, interference characteristic parameters may be configured for each interference source or each type of interference source, and a simulated interference may be generated according to the configured interference characteristic parameters. Therefore, an interference effect consistent with that of a real user equipment may be achieved, thereby more objectively reflecting system performance in different scenarios, saving a test investment and cost, and improving test efficiency.

[0075] Preferably, in this embodiment of the present invention, the parameter configuring module 301 is specifically configured to configure the transmission mode of the one or more simulated load templates, configure the resource utilization rate of the one or more simulated load templates, configure the Rank and the PMI of the one or more simulated load templates, configure the MCS of the one or more simulated load templates, and configure the time domain polling granularity or the frequency domain polling granularity.

[0076] The configuring the transmission mode of the one or more simulated load templates includes: configuring the transmission mode or a transmission scheme of the one or more simulated load templates, and accepting or not accepting a restriction of a characteristic license of an interference cell.

[0077] The configured transmission mode only affects data transmission through a physical downlink shared channel PDSCH, but does not affect pilot transmission of a cell-specific reference signal CRS or values of parameters, such as pilot transmit power, Pa, and Pb, so that simulated load and inter-cell interference coordination ICIC may co-exist. The characteristic license of the interference cell may include MIMO or BF, and may further include another characteristic, such as an active antenna system AAS, frequency-selective scheduling, ICIC, or a power class.

[0078] The configuring the resource utilization rate of the one or more simulated load templates includes: configuring a resource block RB utilization rate and a transmit power utilization rate of the interference cell, where if an RB utilization rate or a transmit power utilization rate that is scheduled by the interference cell and is of a real user equipment UE is lower than a preset threshold, simulated load is scheduled; or if an RB utilization rate or a transmit power utilization rate that is scheduled by the interference cell and is of a real UE is higher than a preset threshold, simulated load is invalid.

[0079] The configuring the Rank and the PMI of the one or more simulated load templates includes: according to the configured transmission mode, setting each of a Rank and a PMI that are corresponding to the transmission mode to a specific value or a preset value range. For a specific value range, refer to Table 1 in the foregoing embodiment.

[0080] The configuring the MCS of the one or more simulated load templates includes: setting the MCS of the one or more simulated load templates to a specific value or a preset value range, that is, a subset from 0 to 28.

[0081] The configuring the time domain polling granu-

larity or the frequency domain polling granularity includes: if multiple simulated load templates are set, separately setting the time domain polling granularity or the frequency domain polling granularity of the simulated load templates to a specific value or a preset value range, where a preset value range of the time domain polling granularity is from 1 ms to infinity, and a preset value range of the frequency domain polling granularity is 1-100 RB.

[0082] In this implementation manner, the simulated interference generating module 302 is specifically configured to: based on different transmission modes and according to a Rank and/or a PMI and/or an MCS configured at a Media Access Control MAC layer or a Radio Resource Control RRC layer, generate a simulated interference; and in a case in which multiple simulated load templates are set, further perform polling between the multiple simulated load templates according to the configured time domain polling granularity or the configured frequency domain polling granularity.

[0083] It may be understood that, with reference to Table 1 and according to the configured interference characteristic parameters, a form of generating a simulated interference in each transmission mode defined by an LTE specification may be as follows:

Based on transmission modes TM1, TM2, and TM3, the PMI is marked as N.A, and N.A indicates that configuration is not required or configuration is invalid. No matter whether and how a Radio Resource Control RRC layer (L3 for short) configures the PMI, a physical layer (L1 for short) and a Media Access Control MAC layer (L2 for short) generate a precoding matrix and a physical downlink shared channel PDSCH signal according to the specification 36.211. It may be understood that L1, L2, and L3 belong to framework content of an eNodeB, and are not specifically explained herein.

Based on transmission mode TM7, the PMI is marked as N.A, that is, it indicates that no matter how L3 configures the PMI, L2 and L1 generate a beam forming matrix and a PDSCH signal according to a used beam forming technology.

Based on transmission mode TM8 or TM9, the PMI may be configured or may not be configured. If the PMI is configured, a precoding matrix and a PDSCH signal are generated according to a codebook defined by the specification 36.211 and the specification 36.213. If the PMI is not configured, a beam forming matrix and a PDSCH signal are generated according to a used beam forming technology.

[0084] In this implementation manner, a process during which the simulated interference generating module 302 is configured to generate a simulated interference may be specifically as follows:

Reference may be made to Table 1. First, the Rank of the one or more simulated load templates is configured as accepting or not accepting license control of MIMO and BF, and not accepting a codebook subset restriction. It is set that 1T-4T represent a quantity of antenna ports of an eNodeB. For transmission modes TM1, TM2, and TM3, a PMI that is input by L3 is meaningless (that is, configuration of the PMI is not required or configuration is invalid), and L2 generates a precoding matrix according to the specification 36.211. In a 2T closed-loop mode (including transmission mode TM4, TM5, or TM6), a PMI scheduled by L2 performs upper and lower limiting processing according to the Rank and the PMI that is input by L3, to ensure that a PMI of Rank1 is 0-3, and a PMI of Rank2 is 1-2, where Rank1 and Rank2 represent a quantity of spatial independent data streams. For 1T, L2 performs simulated scrambling according to transmission mode TM1 and the configured MCS. For 2T or 4T, if the transmission mode is TM1, simulated scrambling is performed according to TM2 and the configured MCS. For TM7, the PMI that is input by L3 is meaningless, and L2 and L1 generate a beam forming matrix according to a used beam forming technology. For TM8 or TM9, if L3 configures the PMI, a precoding matrix is generated according to the codebook defined by the specification 36.211 and the specification 36.213. If the PMI is not configured, a beam forming matrix is generated according to a used beam forming technology.

[0085] Further preferably, the apparatus may further include a parameter copying module, where the parameter copying module is configured to copy the interference characteristic parameters of the one or more simulated load templates to one or more simulated user equipments, and load simulated load to the interference cell by using the one or more simulated user equipments, to reach a preset resource utilization rate of the simulated load.

[0086] Within a TTI, according to a resource allocation type (the LTE specification 36.213 defines three resource allocation types 0, 1, and 2), RB resources are allocated to each simulated load user, so that an RB that can be addressed by a simulated user equipment may not reach a set simulated load level. Therefore, the interference characteristic parameters configured on each of the one or more simulated load templates (equivalent to a simulated load user equipment) need to be copied to one or more simulated user equipments (for example, a maximum of eight user equipments), and reaching a set resource utilization rate of the simulated load is implemented by performing scrambling on these simulated user equipments.

[0087] Further, based on a manner in which an ICIC function is enabled for an interference cell, the parameter copying module may be further configured to copy the interference characteristic parameters of the one or more

simulated load templates to one or more simulated user equipments, and load simulated load to a center frequency band and an edge frequency band by using the one or more simulated user equipments, to reach a preset resource utilization rate of the simulated load.

[0088] If the interference cell enables the ICIC function, a center user and an edge user of the interference cell have different configuration of power control parameters (Pa and Pb). In this case, the parameters configured on each of the one or more simulated load templates are still copied to one or more simulated user equipments (for example, a maximum of 16 user equipments), and reaching the set resource utilization rate of the simulated load is separately implemented in the center frequency band and the edge frequency band by performing scrambling on these simulated user equipments.

[0089] Preferably, the simulated interference generating module 302 is further configured to: if the Radio Resource Control RRC layer only configures some of the interference characteristic parameters, for an interference characteristic parameter that is not configured, perform simulated scrambling according to a default value or in a default manner; or if the RRC layer only configures some of the interference characteristic parameters and the configured interference characteristic parameters are configured as a preset value range, perform simulated scrambling in a manner of performing random selection or polling selection within the preset value range. For example, if the Rank is not configured, simulated scrambling may be performed according to a default Rank1. If the MCS is not configured, simulated scrambling may be performed according to a default MCS; or simulated scrambling may be performed by randomly selecting an MCS; or simulated scrambling may be performed in a manner of performing MCS polling within a range.

[0090] It may be understood that, in combination with the interference characteristic parameters configured by L3, such as the transmission mode, the Rank, the PMI, and the MCS, and with reference to the specification 36.211, pseudo random noise or a specific source signal may be used in this embodiment of the present invention, to generate a PDSCH signal in a processing procedure of a downlink physical channel, and the PDSCH signal is mapped to an antenna of the eNodeB for transmitting.

[0091] It should be noted that, the apparatus for generating a simulated interference may be an eNodeB, that is, a simulated interference is generated on an eNodeB side according to the configured interference characteristic parameters. An independent apparatus (such as a signal generator) may also be used to generate a simulated interference.

[0092] It may be clearly understood by a person skilled in the art that, for convenience and brevity of description, for a detailed working process of the foregoing apparatus for generating a simulated interference, and those of modules in the apparatus, refer to a corresponding process in the foregoing method embodiment for generating a simulated interference, and details are not described herein again.

[0093] It can be learned from the foregoing description that, according to the apparatus for generating a simulated interference provided in this embodiment of the present invention, first, interference characteristic parameters are independently configured for each interference source or each type of interference source, where the configured interference characteristic parameters include a quantity of interference sources, and a transmission mode, a PMI, a Rank, an MCS, transmit power, and a time domain polling granularity or a frequency domain polling granularity of each interference source. Then, simulated interference data is generated according to the configured interference characteristic parameters and is sent over an air interface. A simulated interference of which an interference characteristic is consistent with an interference characteristic of a real user equipment may be obtained, thereby more objectively reflecting system performance in different scenarios, saving a test investment and cost, and improving test efficiency. In the technical solutions of the present invention, an interference effect generated by a simulated interference is equivalent to an interference effect generated by using a real UE, thereby better evaluating or demonstrating performance of a specific technology (such as MIMO or AAS) in a multi-cell scenario. Compared with an interference of a real UE, a simulated interference is relatively flexible, and substantially saves materials and a labor cost.

[0094] Referring to FIG. 4, FIG. 4 is another schematic structural diagram of an apparatus for generating a simulated interference according to an embodiment of the present invention, where the apparatus for generating a simulated interference includes an input apparatus 401, an output apparatus 402, and a processor 403, and the processor 403 performs the following steps:

> setting one or more simulated load templates and separately configuring interference characteristic parameters on the one or more simulated load templates, where one simulated load template is used to simulate one interference or a type of interference that has a same interference characteristic; and
>
> generating a simulated interference by using the interference characteristic parameters configured on the one or more simulated load templates, where if multiple simulated load templates are set, polling is performed, in a time domain and/or a frequency domain, on interferences generated by the multiple simulated load templates by means of simulation.

[0095] The interference characteristic parameters include a transmission mode, a resource utilization rate, a rank Rank, a precoding matrix indicator PMI, and a modulation and coding scheme MCS, and a time domain polling granularity or a frequency domain polling granularity of the one or more simulated load templates. The configuring interference characteristic parameters on the one or more simulated load templates by the processor

403 includes: separately configuring the transmission mode, the resource utilization rate, the Rank, the PMI, the MCS, and the time domain polling granularity or the frequency domain polling granularity of the one or more simulated load templates.

[0096] Further, the processor 403 is configured to: the configuring the transmission mode of the one or more simulated load templates includes: configuring the transmission mode or a transmission scheme of the one or more simulated load templates, and accepting or not accepting a restriction of a characteristic license of an interference cell; the configuring the resource utilization rate of the one or more simulated load templates includes: configuring a resource block RB utilization rate and a transmit power utilization rate of the interference cell, where if an RB utilization rate or a transmit power utilization rate that is scheduled by the interference cell and is of a real user equipment UE is lower than a preset threshold, simulated load is scheduled, or if an RB utilization rate or a transmit power utilization rate that is scheduled by the interference cell and is of a real UE is higher than a preset threshold, simulated load is invalid; the configuring the Rank and the PMI of the one or more simulated load templates includes: according to the configured transmission mode, setting each of a Rank and a PMI that are corresponding to the transmission mode to a specific value or a preset value range; the configuring the MCS of the one or more simulated load templates includes: setting the MCS of the one or more simulated load templates to a specific value or a preset value range; and the configuring the time domain polling granularity or the frequency domain polling granularity includes: if multiple simulated load templates are set, separately setting the time domain polling granularity or the frequency domain polling granularity of the simulated load templates to a specific value or a preset value range, where a preset value range of the time domain polling granularity is from 1 ms to infinity, and a preset value range of the frequency domain polling granularity is 1-100 RB.

[0097] Further, the generating, by the processor 403, a simulated interference by using the interference characteristic parameters includes: based on different transmission modes and according to a Rank and/or a PMI and/or an MCS configured at a Media Access Control MAC layer or a Radio Resource Control RRC layer, generating a simulated interference; and performing polling between the multiple simulated load templates according to the configured time domain polling granularity or the configured frequency domain polling granularity.

[0098] Preferably, the processor 403 may be further configured to copy the interference characteristic parameters of the one or more simulated load templates to one or more simulated user equipments, and load simulated load to the interference cell by using the one or more simulated user equipments, to reach a preset resource utilization rate of the simulated load.

[0099] Preferably, the processor 403 may be further configured to: based on a manner in which an ICIC function is enabled for an interference cell, copy the interference characteristic parameters of the one or more simulated load templates to one or more simulated user equipments, and load simulated load to a center frequency band and an edge frequency band by using the one or more simulated user equipments, to reach a preset resource utilization rate of the simulated load.

[0100] Further preferably, the processor 403 may be further configured to:

if the Radio Resource Control RRC layer only configures some of the interference characteristic parameters, for an interference characteristic parameter that is not configured, perform simulated scrambling according to a default value or in a default manner; or

if the RRC layer only configures some of the interference characteristic parameters and the configured interference characteristic parameters are configured as a preset value range, perform simulated scrambling in a manner of performing random selection or polling selection within the preset value range.

[0101] It may be clearly understood by a person skilled in the art that, for convenience and brevity of description, for a detailed working process of the foregoing apparatus for generating a simulated interference, and that of the processor 403 in the apparatus, refer to a corresponding process in the foregoing method embodiments for generating a simulated interference, and details are not described herein again.

[0102] It can be learned from the foregoing description that, according to the apparatus for generating a simulated interference provided in this embodiment of the present invention, first, interference characteristic parameters are independently configured for each interference source or each type of interference source, where the configured interference characteristic parameters include a quantity of interference sources, and a transmission mode, a PMI, a Rank, an MCS, transmit power, and a time domain polling granularity or a frequency domain polling granularity of each interference source. Then, simulated interference data is generated according to the configured interference characteristic parameters and is sent over an air interface. A simulated interference of which an interference characteristic is consistent with an interference characteristic of a real user equipment may be obtained, thereby more objectively reflecting system performance in different scenarios, saving a test investment and cost, and improving test efficiency. In the technical solutions of the present invention, an interference effect generated by a simulated interference is equivalent to an interference effect generated by using a real UE, thereby better evaluating or demonstrating performance of a specific technology (such as MIMO or AAS) in a multi-cell scenario. Compared with an interference of a real UE, a simulated interference is relatively flexible, and substantially saves materials and a labor cost.

[0103] The following describes another apparatus for generating a simulated interference in an embodiment of the present invention. In this embodiment, the apparatus for generating a simulated interference includes:

a parameter configuring module, configured to configure interference characteristic parameters, where the interference characteristic parameters are used to simulate one interference or a type of interference that has a same interference characteristic, and the interference characteristic parameters include a transmission mode, a rank Rank, and a precoding matrix indicator PMI; and

a simulated interference generating module, configured to generate a simulated interference by using the interference characteristic parameters.

[0104] In this embodiment, the parameter configuring module is specifically configured to configure the transmission mode, the rank Rank, and the PMI.

[0105] The configuring the transmission mode by the parameter configuring module is specifically: configuring the transmission mode or a transmission scheme, and accepting or not accepting a restriction of a characteristic license of an interference cell; and

the configuring the Rank and the PMI by the parameter configuring module is specifically: according to the configured transmission mode, setting each of an Rank and a PMI that are corresponding to the transmission mode to a specific value or a preset value range.

[0106] It may be understood that, in an actual application, in addition to the transmission mode, the rank Rank, and the PMI, the interference characteristic parameters may further include other parameters, such as a resource utilization rate and an MCS. In this embodiment, configuring the resource utilization rate by the parameter configuring module is specifically: configuring a resource block RB utilization rate and a transmit power utilization rate of the interference cell, where if an RB utilization rate or a transmit power utilization rate that is scheduled by the interference cell and is of a real user equipment UE is lower than a preset threshold, simulated load is scheduled; or if an RB utilization rate or a transmit power utilization rate that is scheduled by the interference cell and is of a real UE is higher than a preset threshold, simulated load is invalid; and

configuring the MCS by the parameter configuring module is specifically: setting the MCS to a specific value or a preset value range.

[0107] It may be understood that, in an actual application, in addition to the transmission mode, the rank Rank, and the PMI, the interference characteristic parameters may further include other parameters. For example, when multiple groups of interference characteristic parameters exist, the interference characteristic parameters may further include a time domain polling granularity and/or a frequency domain polling granularity. In this embodiment, configuring the time domain polling granularity and/or the frequency domain polling granularity by the parameter configuring module is specifically: separately setting a time domain polling granularity and/or a frequency domain polling granularity of each of the multiple groups of interference characteristic parameters to a specific value or a preset value range, where a preset value range of the time domain polling granularity is from 1 ms to infinity, and a preset value range of the frequency domain polling granularity is 1-100 RB.

[0108] In this embodiment, the simulated interference generating module is specifically configured to generate the simulated interference based on different transmission modes and according to a Rank and/or a PMI configured at an RRC layer.

[0109] If multiple groups of interference characteristic parameters exist, the simulated interference generating module in this embodiment is specifically configured to generate a simulated interference based on different transmission modes and according to a Rank and/or a PMI configured at an RRC layer; and perform polling between the multiple groups of interference characteristic parameters according to the configured time domain polling granularity and/or the configured frequency domain polling granularity, so that polling is performed, in a time domain or a frequency domain, on simulated interferences generated by the multiple groups of interference characteristic parameters.

[0110] In this embodiment, the apparatus for generating a simulated interference may further include a parameter copying module, configured to copy the interference characteristic parameters to one or more simulated user equipments, and load simulated load to the interference cell by using the one or more simulated user equipments, to reach a preset resource utilization rate of the simulated load;

or

based on a manner in which an ICIC function is enabled for an interference cell, copy the interference characteristic parameters to one or more simulated user equipments, and load simulated load to a center frequency band and an edge frequency band by using the one or more simulated user equipments, to reach a preset resource utilization rate of the simulated load.

[0111] It may be clearly understood by a person skilled in the art that, for the purpose of convenient and brief description, for a detailed working process of the foregoing system, apparatus, and unit, refer to a corresponding process in the foregoing method embodiments, and details are not described herein again.

[0112] In the several embodiments provided in the present application, it should be understood that the disclosed system, apparatus, and method may be implemented in other manners. For example, the described

apparatus embodiment is merely exemplary. For example, the unit division is merely logical function division and may be other division in actual implementation. For example, a plurality of units or components may be combined or integrated into another system, or some characteristics may be ignored or not performed. In addition, the displayed or discussed mutual couplings or direct couplings or communication connections may be implemented through some interfaces. The indirect couplings or communication connections between the apparatuses or units may be implemented in electronic, mechanical, or other forms.

[0113] The units described as separate parts may or may not be physically separate, and parts displayed as units may or may not be physical units, may be located in one position, or may be distributed on a plurality of network units. Some or all of the units may be selected according to actual needs to achieve the objectives of the solutions of the embodiments.

[0114] In addition, functional units in the embodiments of the present invention may be integrated into one processing unit, or each of the units may exist alone physically, or two or more units are integrated into one unit. The integrated unit may be implemented in a form of hardware, or may be implemented in a form of a software functional unit.

[0115] When the integrated unit is implemented in the form of a software functional unit and sold or used as an independent product, the integrated unit may be stored in a computer-readable storage medium. Based on such an understanding, the technical solutions of the present invention essentially, or the part contributing to the prior art, or all or some of the technical solutions may be implemented in the form of a software product. The software product is stored in a storage medium and includes several instructions for instructing a computer device (which may be a personal computer, a server, or a network device) to perform all or some of the steps of the methods described in the embodiments of the present invention. The foregoing storage medium includes: any medium that can store program code, such as a USB flash drive, a removable hard disk, a read-only memory (ROM, Read-Only Memory), a random access memory (RAM, Random Access Memory), a magnetic disk, or an optical disc.

[0116] The method and the apparatus for generating a simulated interference provided in the present invention have been described in detail in the foregoing, and an ordinary person skilled in the art can make variations to specific implementation manners and the application scope without departing from the spirit of the embodiments of the present invention. In conclusion, the content of this specification shall not be understood as a limitation on the present invention.

Claims

1. A method for generating a simulated interference, comprising:

configuring interference characteristic parameters, wherein the interference characteristic parameters are used to simulate one interference or a type of interference that has a same interference characteristic, and the interference characteristic parameters comprise a transmission mode, a rank Rank, and a precoding matrix indicator PMI; and
generating a simulated interference by using the interference characteristic parameters.

2. The method according to claim 1, wherein the configuring interference characteristic parameters comprises:

configuring the transmission mode, the Rank, and the PMI.

3. The method according to claim 2, wherein:

the configuring the transmission mode comprises: configuring the transmission mode or a transmission scheme, and accepting or not accepting a restriction of a characteristic license of an interference cell; and
the configuring the Rank and the PMI comprises: according to the configured transmission mode, setting each of a Rank and a PMI that are corresponding to the transmission mode to a specific value or a preset value range.

4. The method according to any one of claims 2 to 3, wherein the interference characteristic parameters further comprise a resource utilization rate and a modulation and coding scheme MCS; and
the configuring interference characteristic parameters further comprises: configuring the resource utilization rate and the MCS.

5. The method according to claim 4, wherein:

the configuring the resource utilization rate comprises: configuring a resource block RB utilization rate and a transmit power utilization rate of the interference cell, wherein if an RB utilization rate or a transmit power utilization rate that is scheduled by the interference cell of a real user equipment UE is lower than a preset threshold, simulated load is scheduled; or if an RB utilization rate or a transmit power utilization rate that is scheduled by the interference cell and is of a real UE is higher than a preset threshold, simulated load is invalid; and
the configuring the MCS comprises: setting the MCS to a specific value or a preset value range.

6. The method according to any one of claims 2 to 3, wherein if multiple groups of interference characteristic parameters exist, the interference characteristic parameters further comprise a time domain polling granularity and/or a frequency domain polling granularity; and
the configuring interference characteristic parameters further comprises: configuring the time domain polling granularity and/or the frequency domain polling granularity.

7. The method according to claim 6, wherein the configuring the time domain polling granularity and/or the frequency domain polling granularity comprises:

separately setting a time domain polling granularity and/or a frequency domain polling granularity of each of the multiple groups of interference characteristic parameters to a specific value or a preset value range, wherein a preset value range of the time domain polling granularity is from 1 ms to infinity, and a preset value range of the frequency domain polling granularity is 1-100 RB.

8. The method according to any one of claims 1 to 3, wherein the generating a simulated interference by using the interference characteristic parameters comprises:

generating the simulated interference based on different transmission modes and according to a Rank and/or a PMI configured at an RRC layer.

9. The method according to claim 6 or 7, wherein the generating a simulated interference by using the interference characteristic parameters comprises:

generating the simulated interference based on different transmission modes and according to a Rank and/or a PMI configured at an RRC layer; and performing polling between the multiple groups of interference characteristic parameters according to the configured time domain polling granularity and/or the configured frequency domain polling granularity, so that polling is performed, in a time domain and/or a frequency domain, on simulated interferences generated by the multiple groups of interference characteristic parameters.

10. The method according to any one of claims 1 to 3, wherein the method further comprises:

copying the interference characteristic parameters to one or more simulated user equipments, and loading simulated load to the interference cell by using the one or more simulated user equipments, to reach a preset resource utilization rate of the simulated load; or
based on a manner in which an ICIC function is enabled for an interference cell, copying the interference characteristic parameters to one or more simulated user equipments, and loading simulated load to a center frequency band and an edge frequency band by using the one or more simulated user equipments, to reach a preset resource utilization rate of the simulated load.

11. An apparatus for generating a simulated interference, comprising:

a parameter configuring module, configured to configure interference characteristic parameters, wherein the interference characteristic parameters are used to simulate one interference or a type of interference that has a same interference characteristic, and the interference characteristic parameters comprise a transmission mode, a rank Rank, and a precoding matrix indicator PMI; and
a simulated interference generating module, configured to generate a simulated interference by using the interference characteristic parameters.

12. The apparatus according to claim 11, wherein the parameter configuring module is specifically configured to configure the transmission mode, the rank Rank, and the PMI.

13. The apparatus according to claim 12, wherein the configuring the transmission mode by the parameter configuring module is specifically: configuring the transmission mode or a transmission scheme, and accepting or not accepting a restriction of a characteristic license of an interference cell; and
the configuring the Rank and the PMI by the parameter configuring module is specifically: according to the configured transmission mode, setting each of an Rank and a PMI that are corresponding to the transmission mode to a specific value or a preset value range.

14. The apparatus according to any one of claims 12 to 13, wherein the interference characteristic parameters further comprise a resource utilization rate and a modulation and coding scheme MCS; and
the parameter configuring module is further configured to configure the resource utilization rate and the MCS.

15. The apparatus according to claim 14, wherein the configuring the resource utilization rate by the parameter configuring module is specifically: configur-

ing a resource block RB utilization rate and a transmit power utilization rate of the interference cell, wherein if an RB utilization rate or a transmit power utilization rate that is scheduled by the interference cell and is of a real user equipment UE is lower than a preset threshold, simulated load is scheduled; or if an RB utilization rate or a transmit power utilization rate that is scheduled by the interference cell and is of a real UE is higher than a preset threshold, simulated load is invalid; and
the configuring the MCS by the parameter configuring module is specifically: setting the MCS to a specific value or a preset value range.

16. The apparatus according to any one of claims 12 to 13, wherein if multiple groups of interference characteristic parameters exist, the interference characteristic parameters further comprise a time domain polling granularity and/or a frequency domain polling granularity; and
the parameter configuring module is further configured to configure the time domain polling granularity and/or the frequency domain polling granularity.

17. The apparatus according to claim 16, wherein the configuring the time domain polling granularity and/or the frequency domain polling granularity by the parameter configuring module is specifically: separately setting a time domain polling granularity and/or a frequency domain polling granularity of each of the multiple groups of interference characteristic parameters to a specific value or a preset value range, wherein a preset value range of the time domain polling granularity is from 1 ms to infinity, and a preset value range of the frequency domain polling granularity is 1-100 RB.

18. The apparatus according to any one of claims 11 to 13, wherein the simulated interference generating module is specifically configured to:

generate the simulated interference based on different transmission modes and according to a Rank and/or a PMI configured at an RRC layer.

19. The apparatus according to claim 16 or 17, wherein the simulated interference generating module is specifically configured to:

generate the simulated interference based on different transmission modes and according to a Rank and/or a PMI configured at an RRC layer; and perform polling between the multiple groups of interference characteristic parameters according to the configured time domain polling granularity and/or the configured frequency domain polling granularity, so that polling is performed, in a time domain or a frequency domain, on simulated interferences generated by the multiple groups of interference characteristic parameters.

20. The apparatus according to any one of claims 11 to 13, wherein the apparatus further comprises:

a parameter copying module, configured to copy the interference characteristic parameters to one or more simulated user equipments, and load simulated load to the interference cell by using the one or more simulated user equipments, to reach a preset resource utilization rate of the simulated load; or
based on a manner in which an ICIC function is enabled for an interference cell, copy the interference characteristic parameters to one or more simulated user equipments, and load simulated load to a center frequency band and an edge frequency band by using the one or more simulated user equipments, to reach a preset resource utilization rate of the simulated load.

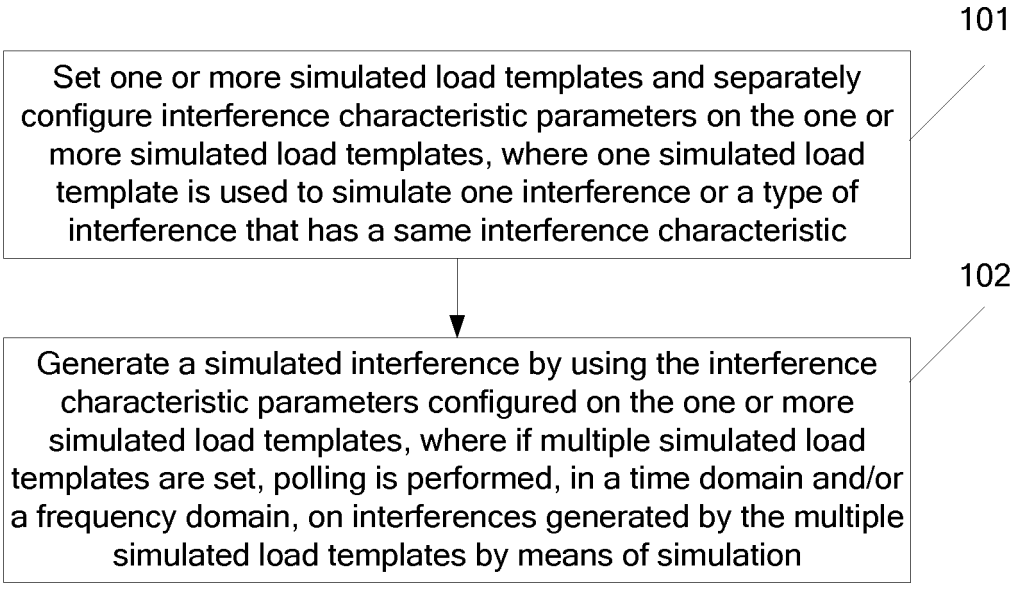
101
Set one or more simulated load templates and separately configure interference characteristic parameters on the one or more simulated load templates, where one simulated load template is used to simulate one interference or a type of interference that has a same interference characteristic
102
Generate a simulated interference by using the interference characteristic parameters configured on the one or more simulated load templates, where if multiple simulated load templates are set, polling is performed, in a time domain and/or a frequency domain, on interferences generated by the multiple simulated load templates by means of simulation

FIG. 1

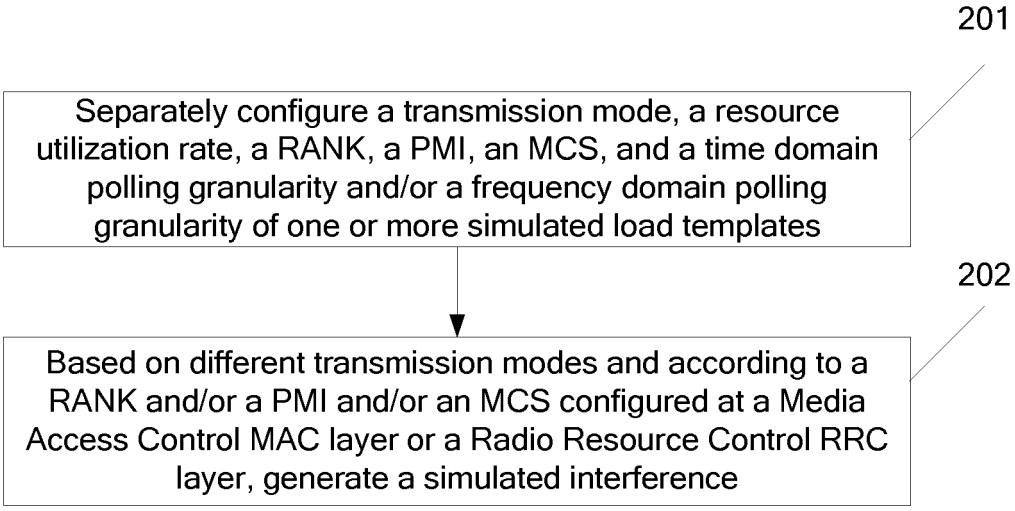
201
Separately configure a transmission mode, a resource utilization rate, a RANK, a PMI, an MCS, and a time domain polling granularity and/or a frequency domain polling granularity of one or more simulated load templates
202
Based on different transmission modes and according to a RANK and/or a PMI and/or an MCS configured at a Media Access Control MAC layer or a Radio Resource Control RRC layer, generate a simulated interference

FIG. 2

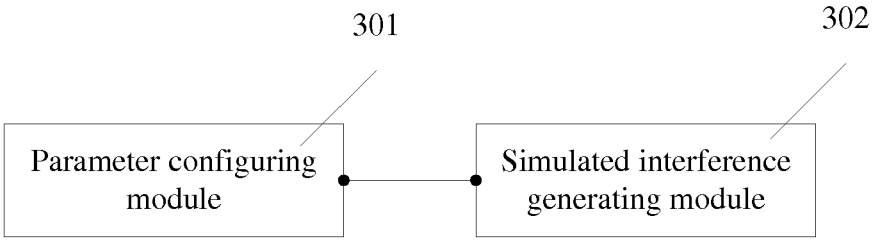
301
302
Parameter configuring module
Simulated interference generating module

FIG. 3

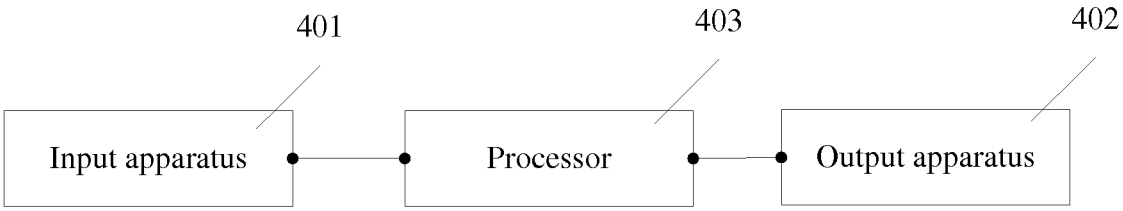
401
403
402
Input apparatus
Processor
Output apparatus

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2014/081645

A. CLASSIFICATION OF SUBJECT MATTER

H04B 17/00 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

H04B H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNPAT, CNKI, WPI, EPODOC: simulated interference, interference characteristic, evaluate, rank, precod+, interference, channel, simulat+, parameter, module, transmission, detect

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 103368670 A (SHANGHAI HUAWEI TECHNOLOGIES CO., LTD.), 23 October 2013 (23.10.2013), description, paragraphs [0043]-[0137], and claims 1-14	1-20
X	CN 103188827 A (SHARP KABUSHIKI KAISHA), 03 July 2013 (03.07.2013), description, paragraphs [0104]-[0159], and figure 6	1-20
A	CN 102255689 A (ZTE CORP.), 23 November 2011 (23.11.2011), the whole document	1-20
A	CN 102742175 A (HUAWEI TECHNOLOGIES CO., LTD.), 17 October 2012 (17.10.2012), the whole document	1-20
A	CN 103125083 A (SAMSUNG ELECTRONICS CO., LTD.), 29 May 2013 (29.05.2013), the whole document	1-20

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 August 2014 (29.08.2014)	**15 October 2014 (15.10.2014)**
Name and mailing address of the ISA/CN: State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No.: (86-10) 62019451	Authorized officer **YANG, Zhen** Telephone No.: (86-10) **62413841**

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2014/081645

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 103368670 A	23 October 2013	None	
CN 103188827 A	03 July 2013	WO 2013099284 A1	04 July 2013
CN 102255689 A	23 November 2011	WO 2013007088 A1	17 January 2013
CN 102742175 A	17 October 2012	WO 2012095049 A2	19 July 2012
CN 103125083 A	29 May 2013	KR 20120033215 A	06 April 2012
		EP 2622758 A1	07 August 2013
		WO 2012044080 A1	05 April 2012
		US 2012106470 A1	03 May 2012

Form PCT/ISA/210 (patent family annex) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 201310283161 **[0001]**